Air Emissions -- The three major sources of air pollutants at a refinery are (1) refining processes, (2) fuel combustion by vehicles and processing equipment, and (3) leaks and evaporation from valves and seals at processing units and storage tanks. As with all other environmental impacts, the magnitude of air emissions will depend on the amount of oil refined, the crude oil's chemical characteristics, plant design, and government emission standards.

Processing emissions come primarily from catalytic cracking and coking operations. Catalytic cracking alters the molecular structure of hydrocarbons by heat and catalytic conversion; the process gives off carbon monoxide, sulfur oxides, hydrocarbons, and particulate matter. Spent catalysts from the cracking process are reclaimed by passing them through a vessel which burns off residual coke and primarily generates particulate matter. Coking is a decarbonization process which increases the crude oil stream's yield of lighter, distillate fuels (such as gasoline) relative to its yield of heavier residual fuel oils. Particulate emissions from cracking and coking may be substantially reduced by using electrostatic precipitators ("scrubbers"). Table 10 shows emissions from each process.

Vehicles and processing machinery at a refinery contribute significant amounts of air pollutants. Processing machinery includes compressors and external combustion boilers. Emission volumes depend on the number and size of the boilers and compressors and the fuel used to power them. Table 11 summarizes average emissions from boilers and compressors at a refinery. Compressors are often powered by electric motors but can be powered by natural gas or refinery product gas. Gas combustion emissions consist primarily of hydrocarbons and sulfur oxides, the level of which will depend on the gas's sulfur content. Boilers are usually powered by oil or gas from the refinery and primarily generate sulfur oxides, nitrogen oxides, and particulates. The emission of nitrogen oxides from boilers can be reduced by using biased firing or staged firing. Biased firing uses various mixtures of air and fuel in different burners. Staged firing burns fuel-rich mixtures first, then injects air above the burner's flame to ensure more complete combustion. Fuel combustion by employee automobiles and by the tank trucks and tankers used to transport refinery products and crude oil will add carbon monoxide, hydrocarbons, and nitrogen oxides to the air at and near the refinery.

Valve and seal leakage and the evaporation of hydrocarbons will occur at all stages of the refining process, particularly at those stages which require high pressures and which transfer fuel from storage tanks to tankers, trucks, and rail cars. The combined average emission of hydrocarbons from various valves and seals is about 61 pounds per 1,000 barrels of oil processed (NERBC, Factbook, p. 6.26). The most effective means of controlling these emissions is a well structured maintenance program.

Sulfur dioxide, particulate, and carbon monoxide emissions from coking units are currently regulated by the federal government. In addition to meeting these "source" emission standards, a new refinery must obtain a federal air quality permit. Approval of this permit is contingent on the